Determinants of Metabolic Syndrome among Malaysian Government Employees

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ABSTRACT

Introduction: The metabolic syndrome comprises a collection of cardiovascular disease risks, which has been demonstrated to predict type 2 diabetes mellitus and cardiovascular disease. Metabolic syndrome is a crucial health concern in Malaysia, with a prevalence of about 42.5% in the general population based on the 'Harmonized' definition. The aim of this study was to ascertain the association between socioeconomic status among Malaysian government employees with metabolic syndrome, compared with those without metabolic syndrome. Furthermore, this study also aimed to ascertain the associated obesity indicators for metabolic syndrome among employees—explicitly body mass index, waist circumference, waist-to-hip ratio, body fat percentage, fat mass index, and waist-to-height ratio. **Methods:** This cross-sectional study was undertaken at government agencies in Putrajaya, Malaysia, via multi-stage random sampling. A total of 675 government employees were randomly sampled from a list of 3,173 government employees working in five government agencies under five geographical areas. Data on socioeconomic status, anthropometric, biochemical, and clinical assessments were collected. **Results:** Employees who were males had higher metabolic syndrome prevalence compared to their counterparts (p=0.019). In addition, employees aged between 20 to younger than 30 years had lowest metabolic syndrome prevalence (p=0.002). The risk of having metabolic syndrome was almost 10 times more likely in men with a waist-to-hip ratio of ≥0.90 compared to men with a waist-to-hip ratio of <0.90 (p<0.001). Women with a waist-to-hip ratio of ≥0.85 were approximately 33 times more likely to have metabolic syndrome as compared to women with waist-to-hip ratios of <0.85 (p<0.001). Men with a waist circumference of ≥90 cm were approximately twice as likely to have metabolic syndrome, compared to men with waist circumferences of <90 cm (p=0.030). The risk of having metabolic syndrome was almost three times more likely in women with a waist circumference of ≥80 cm compared to women with waist circumferences of <80 cm (p<0.001). Furthermore, the risk of having metabolic syndrome was almost five times more likely in women with fat mass indexes in Quartile 4 (≥7.93), compared to women with fat mass indexes in Quartile 1 (<5.25) [p<0.001]. On the other hand, men with waist-to-height ratios of <0.445 were 75% less likely to have metabolic syndrome as compared to men with waist-to-height ratios of ≥0.625 (p=0.020). Women with waist-to-height ratios of 0.445 to <0.525 were 95% less likely to have metabolic syndrome as compared to women with waist-to-height ratios of ≥0.625 (p<0.001). In addition, women with waist-to-height ratios of 0.525 to <0.625 were 77% less likely to have metabolic syndrome as compared to women with waist-to-height ratios of ≥0.625 (p<0.001). **Conclusion:** Gender and age were associated with metabolic syndrome prevalence. Waist-to-hip ratio, waist circumference, and waist-to-height ratio seems to be the better obesity indicators to predict the presence of metabolic syndrome than body mass index and body fat percentage in both men and women.

KEYWORDS: metabolic syndrome x, government, employees, socioeconomic status, risk

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INTRODUCTION

The metabolic syndrome comprises a collection of cardiovascular disease risks. The major cardiovascular disease risks are obesity, high blood pressure, dyslipidaemia, high blood glucose, and unhealthy lifestyles. The clustering of these cardiovascular disease risks has been demonstrated to predict type 2 diabetes mellitus and cardiovascular disease.[1] Metabolic syndrome is a crucial health concern in Malaysia, with a prevalence of about 42.5% in the general population based on the

'Harmonized' definition.[2] Rapid socioeconomic developments will give rise to lifestyle modifications, and eventually lead to the increased prevalence of obesity and related conditions, such as dyslipidaemia and diabetes, which are believed to be part of the nutrition transition process.

Obesity is one of the fundamental clinical criteria of metabolic syndrome. The combination of cardiovascular risks consisting of high blood pressure, dyslipidaemia, high blood glucose/type 2 diabetes mellitus and obesity (specifically abdominal obesity) are major criteria for metabolic syndrome. The rising prevalence of overweight individuals and obesity is an established risk for metabolic syndrome.[3]

Although body mass index is the most commonly employed approach to evaluate obesity, this approach has been criticized, as body mass index does not always reveal true body fat value[4] and has some drawbacks in evaluating the risk of obesity-associated health problems among individuals with high body fat percentages.

Madeira and colleagues discovered that having a high body fat percentage with normal body mass index was associated with metabolic syndrome, and recommended that clinical evaluation of excess body fat in individuals with normal body mass should commence as early as possible.[5] It appears that the true body fat value may be better revealed by the assessment of body fat mass.[6] Hence, many studies have scrutinized the probable role of body composition assessments.

Body fat percentage does not fine-tune appropriately for body size, albeit height has been demonstrated as an independent risk for cardiovascular disease.[7] Hence, body fat mass should be adjusted for body size. After recognizing this issue, a fat mass index which considers an individual's height has been proposed.[8] This calculated fat mass index removes the differences of body fat percentage associated with an individual's height, and may be a practical measure of obesity.[9]

The aim of this study was to ascertain the association between socioeconomic status among Malaysian government employees with metabolic syndrome, compared with those without metabolic syndrome. In addition, this study also aimed to ascertain the associated obesity indicators for metabolic syndrome among employees, explicitly body mass index, waist circumference, waist-to-hip ratio, body fat percentage and fat mass index. Acknowledging these factors will aid in developing an effective intervention that targets employees based on obesity indicators to prevent the development of metabolic syndrome, and eventually to combat type 2 diabetes mellitus and the cardiovascular disease crisis.

MATERIALS AND METHODS

Participants and study design

A minimum sample size of 385 was obtained with the formula by Daniel.[10] The maximum value for "n" was attained by employing the proportion of 0.5.[11] This cross-sectional study was undertaken at government agencies in Putrajaya, Malaysia, via multi-stage random sampling. A total of five geographical areas were randomly selected, and one government agency was randomly selected from each of the five geographical areas. A total of 675 government employees were randomly sampled with the Table of Random Numbers from a list of 3,173 government employees working in those five government agencies.

Procedures

Approval for this study was granted by the Medical Research Ethics Committee of the Faculty of Medicine and Health Sciences, Universiti Putra Malaysia.

Measurements

Individuals with metabolic syndrome were ascertained according to the 'harmonized' definition[12] after reviewing data on waist circumference, blood pressure, and blood tests (parameters include triglycerides, HDL cholesterol and glucose). The most recent 'harmonized' definition of metabolic syndrome was developed by the American Heart Association; International Association for the Study of Obesity; International Diabetes Federation Task Force on Epidemiology and Preventive; National Heart, Lung and Blood Institute; and World Heart Federation, in an attempt to harmonize the definition for metabolic syndrome.

Body fat percentage was evaluated with bio-electrical impedance, via the octopolar Tanita segmental body composition analyser model 418 (Tanita Corporation, Tokyo, Japan), which encompasses eight tactile electrodes. The instrument comprises four stainless-steel rectangular footpad electrodes attached to a metal platform set upon force transducers for weight assessment, and two handgrips with an anterior and posterior electrode. Hence, the instrument has eight electrodes: two for each hand and two for each foot. Assessments were conducted at 50 kHz with a sinus wave constant current. The resistance of the trunk and limbs was assessed by linking consecutively several combinations of two voltage and two current electrodes. Specifically, the current that flows into the body is hampered by the fat tissue but moves through the water, which is observed in the muscle tissues. The grade of difficulty in which the current delivered through the body was taken as electrical resistance, and was employed to extrapolate the body fat percentage. After the entry of demographic information, an individual stood on the metal footplate with bare feet, and held the handgrips until the Tanita BC-418 printed the results (body fat percentage and fat mass). The categorization of body fat percentage was according to the cut-off proposed by Nagamine.[13]

The body fat percentage assessed with the Tanita BC-418 has been demonstrated to strongly correlate (r=0.87, p<0.001) with the dual energy X-ray absorptiometry.[14] In view of the impedance variation with the distribution of body fluid, an individual was requested to urinate prior to the measurement of body fat percentage to improve accuracy.

Further methodological details of the measurement of waist circumference, hip circumference, weight, height, blood pressure, and blood-taking procedures have been described elsewhere.[15,16]

Statistical analysis
Data were analysed using the SPSS version 22.0 software. Chi-square (x^2) was performed to test the differences in socioeconomic status between employees who have metabolic syndrome and those who do not have metabolic syndrome. Logistic regression analysis was performed to examine the determinants of metabolic syndrome. Crude odds ratio was computed. Statistical significance was set at a p-value of ≤0.05.

RESULTS

Out of the total of 675 government employees selected via multi-stage random sampling from five government agencies in Putrajaya, 659 employees agreed to participate, which was equivalent to a response rate of 97.6%. Employees' socioeconomic status has been described elsewhere.[15]

The prevalence of metabolic syndrome based on 'harmonized' definition was generally higher in males (57.1%) than females (46.3%). On the other hand, the prevalence of metabolic syndrome was lowest in participants aged between 20 to below 30 years (38.9%).

No significant association was observed between body mass index (Table I), body fat percentage, and the odds of having metabolic syndrome. In general, there was a significant association between waist-to -hip ratio and the odds of having metabolic syndrome. The risk of having metabolic syndrome was almost 10 times more likely in men with waist-to-hip ratios of ≥0.90 compared to men with waist-to-hip ratios of <0.90 (p<0.001). Women with waist-to-hip ratios of ≥0.85 were approximately 33 times more likely to have metabolic syndrome as compared to women with waist-to-hip ratios of <0.85 (p<0.001).

On the other hand, there was also a significant association between waist circumference and the odds of having metabolic syndrome. Men with waist circumferences of ≥90 cm were approximately twice as likely to have metabolic syndrome as compared to men with waist circumferences of <90 cm (p=0.030). The risk of having metabolic syndrome was almost three times more likely in women with waist circumferences of ≥80 cm compared to women with waist circumferences of <80 cm (p<0.001). In addition, the risk of having metabolic syndrome was almost five times more likely in women with fat mass indexes in Quartile 4 (≥7.93) compared to women with fat mass indexes in Quartile 1 (<5.25).

Nevertheless, men with waist-to-height ratios of <0.445 were 75% less likely to have metabolic syndrome as compared to men with waist-to-height ratios of ≥0.625 (p=0.020). In addition, women with waist-to-height ratios of 0.445 to <0.525 were 95% less likely to have metabolic syndrome as compared to women with waist-to-height ratios of ≥0.625 (p<0.001). Women with waist-to-height ratios of 0.525 to <0.625 were 77% less likely to have metabolic syndrome as compared to women with waist-to-height ratios of ≥0.625 (p<0.001).

DISCUSSION

Findings from this study support the hypothesis that demographic factors (e.g., gender and age) were associated with metabolic syndrome prevalence among employees. The effect of some of the socioeconomic status aspects on metabolic syndrome might vary in a different population.[17] In this study, gender and age had the significant role in this regard. On the other hand, earlier studies in developing countries revealed that metabolic syndrome was associated with a low grade of employment.[18] More males (57.1%) than females (46.3%) were having metabolic syndrome. This implies that gender is likely to be part of the determinants for metabolic syndrome observed among Malaysians.

Metabolic syndrome is related to the development of type 2 diabetes mellitus and cardiovascular disease, which is the principal cause of mortality worldwide[19] and is epidemical in Malaysia[2], along with other developing countries. In this study, body mass index, body fat percentage, waist-to-hip ratio, waist circumference, and fat mass index measurements were employed to predict the presence of metabolic syndrome. Among the obesity indicators employed to screen the presence of metabolic syndrome, researchers observed that waist-to-hip ratio and waist circumference were associated with metabolic syndrome. In other words, waist-to-hip ratio and waist circumference were the significant determinants of metabolic syndrome among both male and female employees. After all, waist circumference is part of the 'harmonized' definition of metabolic syndrome.

Furthermore, waist-to-height ratio combined height and waist circumference, which is more conveniently and frequently measured than hip circumference.

Table I: Odds ratio and 95% confidence intervals (CI) for the presence of metabolic syndrome according to the body mass index, body fat percentage, waist-to-hip ratio, waist circumference and fat mass index in men and women

Obesity indicators	n (%)	Odds ratio (95% CI)	p-value
Body mass index (kg/m^2)			
Men			
Underweight (Less than 18.50 kg/m^2)	3 (1.9)	1.000	
Normal weight (18.50 to 24.99 kg/m^2)	43 (27.9)	1.071 (0.090, 12.807)	0.957
Overweight or obese (25.00 kg/m^2)	108 (70.1)	4.000 (0.351, 45.598)	0.264
Women			
Underweight (Less than 18.50 kg/m^2)	14 (2.8)	1.000	
Normal weight (18.50 to 24.99 kg/m^2)	224 (44.4)	0.674 (0.217, 2.090)	0.494
Overweight or obese (25.00 kg/m^2)	267 (52.9)	3.055 (0.996, 9.372)	0.051
Body fat percentage (%)			
Men			
10.0 to 19.9	17 (11.0)	1.000	
20.0 to 24.9	21 (13.6)	0.571 (0.148, 2.210)	0.417
≥25	116 (75.3)	2.613 (0.925, 7.380)	0.070
Women			
Less than 20.0	2 (0.4)	1.000	
20.0 to 29.9	81 (16.0)	0.266 (0.016, 4.469)	0.357
30.0 to 34.9	111 (22.0)	0.500 (0.030, 8.220)	0.628
≥35	311 (61.6)	1.356 (0.084, 21.878)	0.830
Waist-to-hip ratio			
Men			
<0.90	80 (51.9)	1.000	
≥0.90	74 (48.1)	9.643 (3.875, 23.994)	<0.001*
Women			
<0.85	256 (50.7)	1.000	
≥0.85	249 (49.3)	32.572 (11.757, 90.244)	<0.001*
Waist circumference			
Men			
<90	37 (24)	1.000	
≥90	117 (76)	2.061 (1.074, 3.952)	0.030*
Female			
<80	102 (20.2)	1.000	
≥80	403 (79.8)	2.998 (2.085, 4.310)	<0.001*
Fat mass index (kg/m^2)			
Men			
Quartile 1 (<4.39)	16 (10.4)	1.000	
Quartile 2 (4.39 to <5.65)	15 (9.7)	0.321 (0.065, 1.600)	0.166
Quartile 3 (5.65 to <7.03)	27 (17.5)	1.029 (0.296, 3.575)	0.965
Quartile 4 (≥7.03)	96 (62.3)	2.829 (0.963, 8.312)	0.059
Women			
Quartile 1 (<5.25)	35 (6.9)	1.000	
Quartile 2 (5.25 to <6.33)	51 (10.1)	0.723 (0.249, 2.104)	0.552
Quartile 3 (6.33 to <7.93)	93 (18.4)	1.607 (0.653, 3.956)	0.302
Quartile 4 (≥7.93)	326 (64.6)	4.540 (2.002, 10.298)	<0.001*
Waist-to-height ratio			
Men			
Quartile 1 (<0.445)	4 (2.6)	0.167 (0.015, 1.869)	0.146
Quartile 2 (0.445 to <0..525)	27 (17.5)	0.250 (0.078, 0.803)	0.020*
Quartile 3 (0.525 to <0.625)	99 (64.3)	0.838 (0.327, 2.148)	0.713
Quartile 4 (≥6.25)	24 (15.6)	1.000	
Women			
Quartile 1 (<0.445)	8 (1.6)	0.000 (0.000, -)	0.999
Quartile 2 (0.445 to <0.525)	139 (27.5)	0.055 (0.029, 0.105)	<0.001*
Quartile 3 (0.525 to <0.625)	254 (50.3)	0.227 (0.132, 0.392)	<0.001*
Quartile 4 (≥0.625)	104 (20.6)	1.000	

* Significant at p≤0.05

Waist-to-height ratio continues to demonstrate well the abdominal visceral fat, and removes the difference in body size. It may enhance the ability of waist circumference to predict cardiometabolic risk.[20] However, waist-to-height ratio is not as common as waist-to-hip ratio in epidemiological studies. This is one of the few papers to focus on waist-to-height ratio. It is timely, due to the growing popularity of this anthropometric index with the number of papers demonstrating that it functions well for screening for cardiometabolic risk.[21] The similar cut-off point for waist-to-height ratio has been applied in the study conducted by Mi et al.[20], which revealed that the waist-to-height ratio is the most significant anthropometric index with newly diagnosed diabetes mellitus than other indexes. Compared with the lowest waist-to-height ratio (<0.445), those with waist-to-height ratios of 0.445 to <0.525 had approximately three times the risk of newly diagnosed diabetes mellitus, while those with highest waist-to-height ratio had 16 times the risk of newly diagnosed diabetes mellitus. The waist-to-height ratio has been claimed as an alternative anthropometric index of abdominal obesity that evades the drawbacks of waist circumference.[22]

Waist-to-height ratio has been demonstrated to indicate cardiometabolic risk among individuals who are not obese, based on other anthropometric indicators.[23] The most effective screening approaches must be effective as well as practical. Body mass index needs measures of height and weight, while waist-to-height ratio needs measures of height and waist circumference. Self-assessment of height is recognized to be more accurate than that of weight[24] and the waist circumference measurements need a simple measuring tape rather than a weighing scale. Notably, the waist-to height ratio provides benefits of a simple cut-off value, which could be applied for men and women of all ethnic groups.[22]

Furthermore, this study demonstrated that a high fat mass index (≥7.95) had significantly higher odds ratio for metabolic syndrome than a low fat mass index (<5.25) in women, whereas Wang and colleagues[25] found significant association in both genders. The differences in these findings could be due to the different instruments employed to measure body composition, in which body composition was assessed by dual energy X-ray absorptiometry in the study conducted by Wang and colleagues.[25]

We recommend that more preventative efforts be taken against metabolic syndrome among men and employees aged above 30 years who have high waist -to-hip ratios (men≥0.90; women≥0.85); high waist circumferences (men≥90 cm; women≥80 cm); high waist-to-height ratio (≥0.625); and women with fat mass indexes of ≥7.95.

This study has its strengths and limitations. We assessed a large sample of employees that incorporated both employees with and without metabolic syndrome. However, the limitation of this study was its cross-sectional design, which leads to difficulty in addressing causal relations.

Despite the limitations, this study recommended that waist-to-hip ratio, waist circumference and waist-to-height ratio seem to be the better obesity indicators to predict the presence of metabolic syndrome than body mass index and body fat percentage in both men and women. In conclusion, identifying the determinants might warrant future intervention studies among specific population.

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